

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Thomas Kocovsky (Reg. No. 28,383) on March 1, 2010.

The application has been amended as follows:

3. An apparatus for navigating an instrument through an anatomical structure of a patient's body volume, the apparatus comprising:

a table for supporting the patient;

at least a first C-arm having a first X-ray source and a first X-ray detector configured to acquire a first series of 2D-images of the instrument while manoeuvring through said anatomical structure; and

a processing unit connected to a memory device, the memory device configured to hold pre-determined 3D-images of the patient's anatomical structure and hold a pre-determined 3D-model representation of the instrument[[,]] and

wherein the processing unit is configured to: process the 2D-images of the instrument and the 3D-images of the anatomical structure to provide merged 3D-images of the instrument manoeuvring through said anatomical structure, the processing unit

performing a 2D-3D registration to relate coordinates of the 2D-images of the instrument to coordinates of the 3D-images of the anatomical structure prior to providing the merged 3D images of the instrument and the anatomical structure;

wherein the memory device holds a pre-determined 3D-model representation of the instrument; and

wherein the processing unit is configured to:

perform a 2D-3D registration to relate the coordinates of the 3D-model representation of the instrument with the coordinates of the 2D-images of the instrument,

calculate projections of the 3D-model representation to generate 2D-model images of the instrument corresponding to the acquired 2D-images of the instrument,

modify the 3D-model representation in order to optimize matching of the 2D-model images to the acquired 2D-images of the instrument to derive an adapted 3D-model representation of the instrument, and

merge the adapted 3D-model representation of the instrument with the 3D-images of the anatomical structure to provide the merged 3D-images of the instrument manoeuvering through said anatomical structure.

4. The apparatus according to claim 3, further comprising:

a second C-arm with a second X-ray source and a second X-ray detector for acquiring a second series of 2D-images of the instrument simultaneously with the first series of 2D-images of the instrument;

wherein the processing unit is configured to:

register the coordinates of the 3D-model representation respective to both the first series and the second series of 2D-images of the instrument, and

derive the adapted 3D-model representation of the instrument based on both the first series and the second series of 2D-images of the instrument, ~~and~~.

7. A method for navigating an instrument through an anatomical structure of a patient's body volume, the method comprising:

acquiring a first series of 2D-images of the instrument while maneuvering the instrument through the anatomical structure;

acquiring 3D images of the patient's anatomical structure;

acquiring a 3D-model representation of the instrument; and

processing the 2D-images of the instrument and 3D-images of the patient's anatomical structure to generate merged 3D-images of the instrument manoeuvering through the anatomical structure by performing the steps of; wherein the 2D-images of the instrument are

~~registered with~~registering the acquired 3D-images of the anatomical structure with the 2D images of the instrument prior to generating the merged 3D-images of the instrument and the anatomical structure, wherein the processing includes:

registering the acquired 3D-model representation of the instrument with the 2D-images of the instrument,

deriving 2D-model images of the instrument from said 3D-model representation of the instrument, the 2D-model images corresponding to the acquired 2D-images of the instrument,

~~adapting~~modifying said 3D-model representation to optimize matching of the derived 2D-model images with the acquired 2D-images of the instrument, the ~~adapting~~modifying generating an adapted 3D-model representation of the instrument, and

merging the adapted 3D-model representation of the instrument with the ~~3D images of the patient's~~ anatomical structure to generate the merged 3D-images of the instrument manoeuvring through the anatomical structure.

8. The method according to claim 7, further comprising:

acquiring a second series of 2D-images ~~of the instrument~~ simultaneously with the acquiring of the first series of 2D-images of the instrument, the second series of 2D-images being acquired ~~but~~ from a different angle compared with the first series of 2D-images,

wherein:

the registering includes registering the coordinates of the 3D-model representation of the instrument respective to both the first series and the second series of 2D-images of the instrument, and

the ~~adapting~~modifying includes ~~adapting~~modifying the 3D-model representation of the instrument to optimize the matching of said first series and second series of ~~2D~~-images of the instrument with ~~the~~ 2D-model images of the instrument derived from said 3D-model representation.

11. A non-transitory computer readable medium having, stored thereon, computer executable software for navigating an instrument through an anatomical structure of a patient's body volume, the software comprising instructions for causing a computer to implement the steps of:

~~requiring~~receiving a first series of 2D-images of the instrument while manoeuvring through the anatomical structure;

receiving 3D images of the patient's anatomical structure;
receiving a 3D-model representation of the instrument; and

processing the 2D-images of the instrument and the 3D-images of the patient's anatomical structure to generate merged 3D-images of the instrument manoeuvring through the anatomical structure, the processing including by performing the steps of:

registering the 2D-images of the instrument with the 3D-images of the anatomical structure by,

registering [[a]] the 3D-model representation of the instrument with the 2D-images of the instrument,

deriving 2D-model images of the instrument from said 3D-model representation, the 2D-model images corresponding to the required received 2D-images of the instrument, and

adapting modifying the 3D-model representation in order to optimize matching of the 2D-model images with the required received 2D-images of the instrument to generate an adapted 3D-model representation of the instrument, and

merging the adapted 3D-model representation of the instrument with the 3D images of the patient's anatomical structure to generate the merged 3D-images of the instrument manoeuvring through the anatomical structure.

12. The software stored on the non-transitory computer readable medium according to claim 11, wherein said first series of 2D-images of the instrument and a second series of 2D-images of the instrument are required received simultaneously, but from a different angle, by the requiring receiving step, and wherein:

the registering includes registering the coordinates of the 3D-model representation of the instrument respective to both the first series and the second series of 2D-images of the instrument, and

the adapting modifying includes adapting the 3D-model representation of the instrument in order to optimize the matching of said first series and second series of images of the instrument with the 2D-model images of the instrument derived from said 3D-model representation.

14. A method comprising:

processing 2D-images of an instrument acquired from one or more viewing angles during maneuvering of the instrument through an anatomical structure of a patient's body volume to generate 3D-images of the instrument manoeuvring through the anatomical structure, the processing including by performing the steps of:

registering a 3D-model representation of the instrument and with the acquired 2D-images of the instrument,

projecting calculating projections of the 3D-model representation to derive 2D-model images of the instrument from the one or more viewing angles, and

adapting modifying the 3D-model representation to optimally match the projected derived 2D-model images and the acquired 2D-images of the instrument to derive an adapted 3D-model representation of the instrument, and

merging the adapted 3D-model representation of the instrument and a 3D-image of the patient's anatomical structure to generate the 3D-images of the instrument maneuvering through the anatomical structure.

18. (Canceled)

20. A non-transitory computer readable medium having, stored thereon, computer executable software comprising instructions for causing a computer to perform the method of claim 14.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JACQUELINE CHENG whose telephone number is (571)272-5596. The examiner can normally be reached on M-F 10:00-6:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Long Le can be reached on 571-272-0823. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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